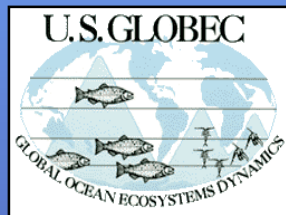


Regional Prevalences of *Renibacterium salmoninarum* Among Juvenile Salmon in the Northeast Pacific Ocean



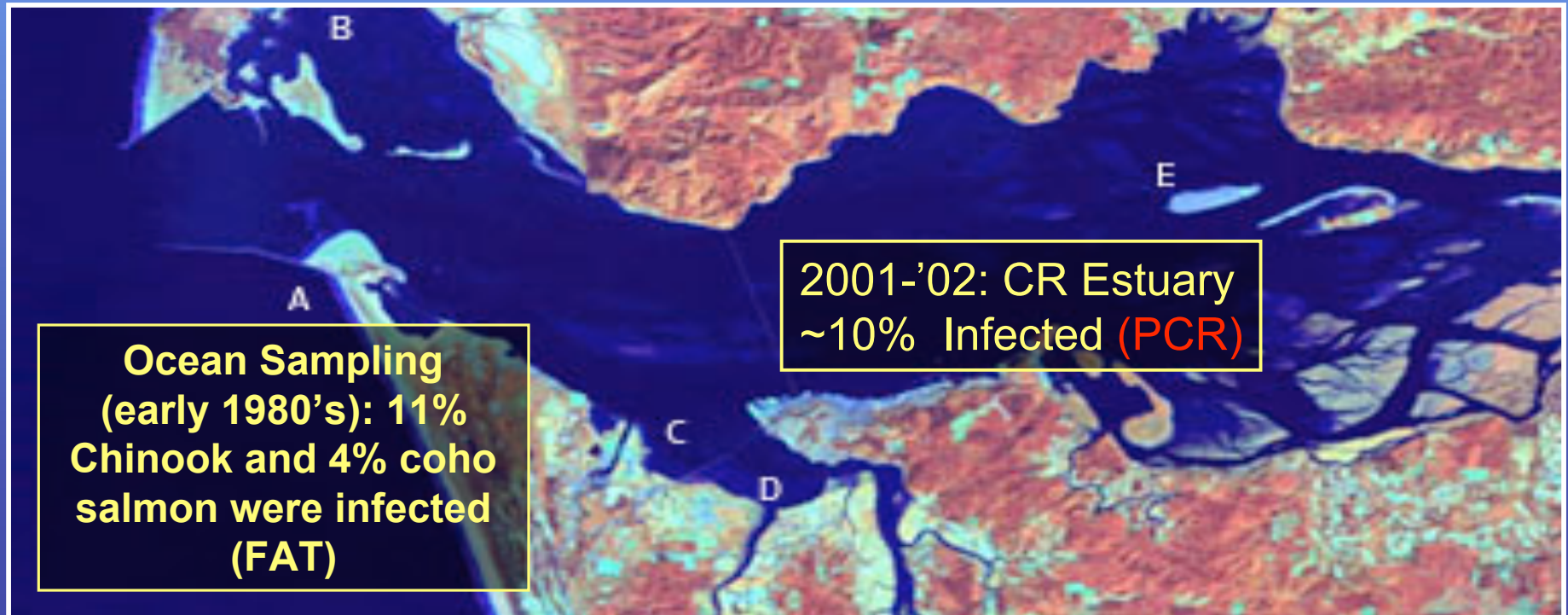
Todd Sandell*
Kym Jacobson
Ed Casillas

Project Goals - *Renibacterium salmoninarum*

- Determine the prevalence and severity of *R. salmoninarum* in ocean-caught juvenile salmon (nested PCR, AK)
 - Are coho and Chinook salmon affected differently?
 - Does infection status correlate with fish “condition”?
 - Is there evidence of *R. salmoninarum* -related mortality?
- Are there differences in prevalence between hatchery and naturally-reproducing salmon stocks?
- Determine if regional and/or temporal differences in prevalence or severity occur
- What are the oceanographic/atmospheric factors that influence *R. salmoninarum* in ocean salmon?

R. salmoninarum in juvenile Chinook and Coho in the Columbia River Estuary and NEP

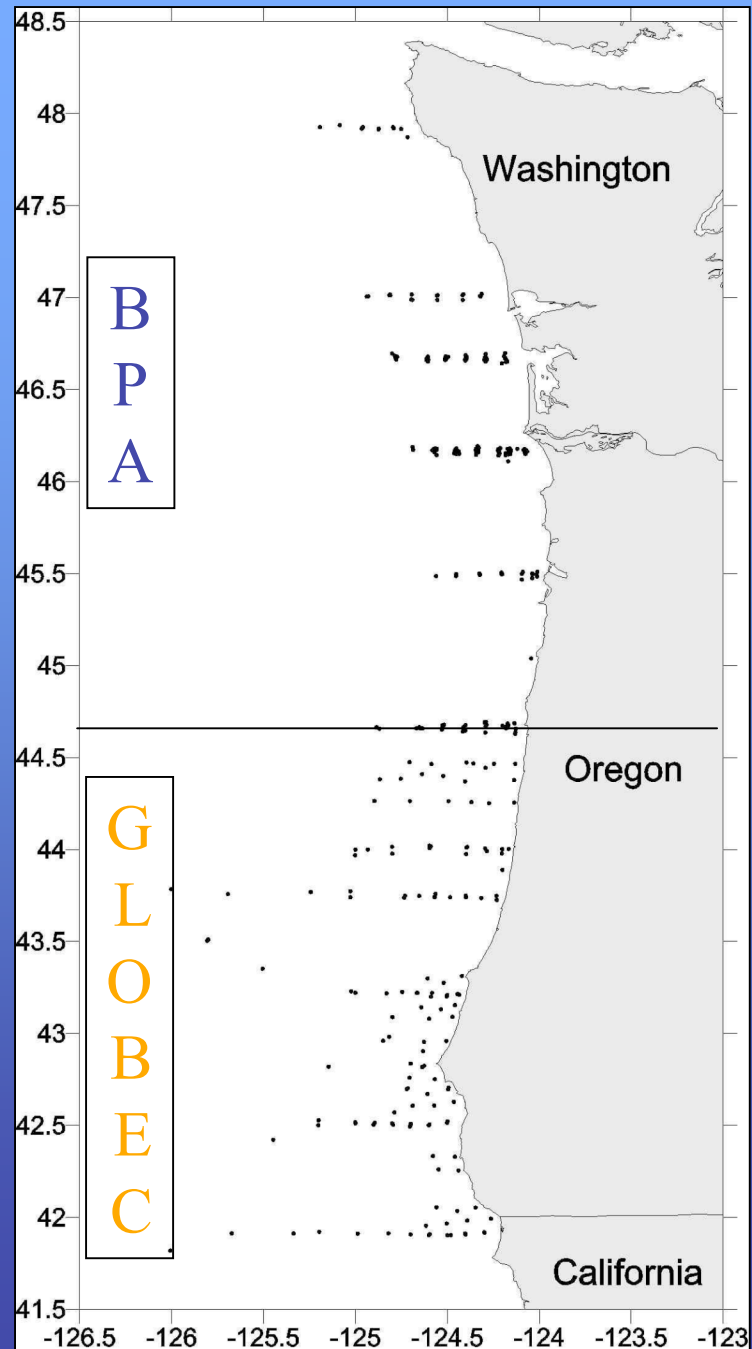
1998: 58.4% CHS and 49.9% coho salmon infected (ELISA)
In fish caught off B.C.



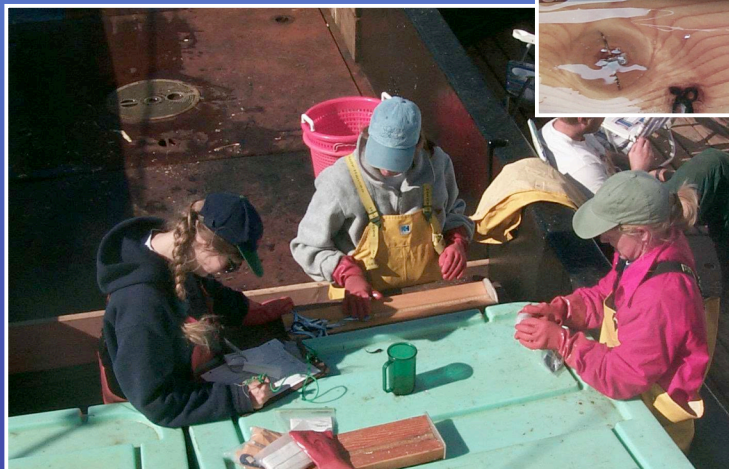
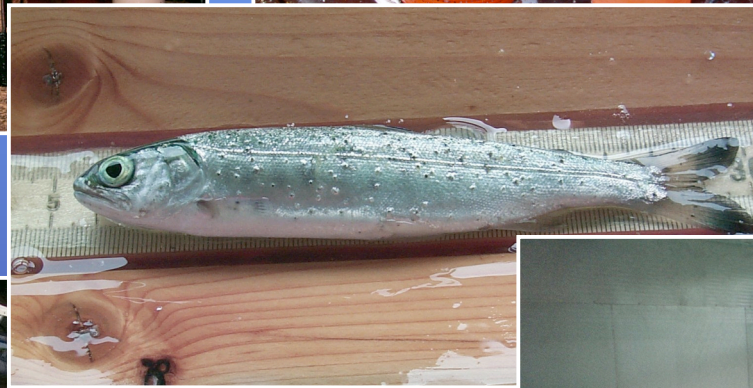
“LOCAL” STUDY AREAS

I. BPA Columbia
River Plume study
[2000-2006]

II. GLOBEC (Global
Ocean Ecosystem
Construction)
[2000, 2002]

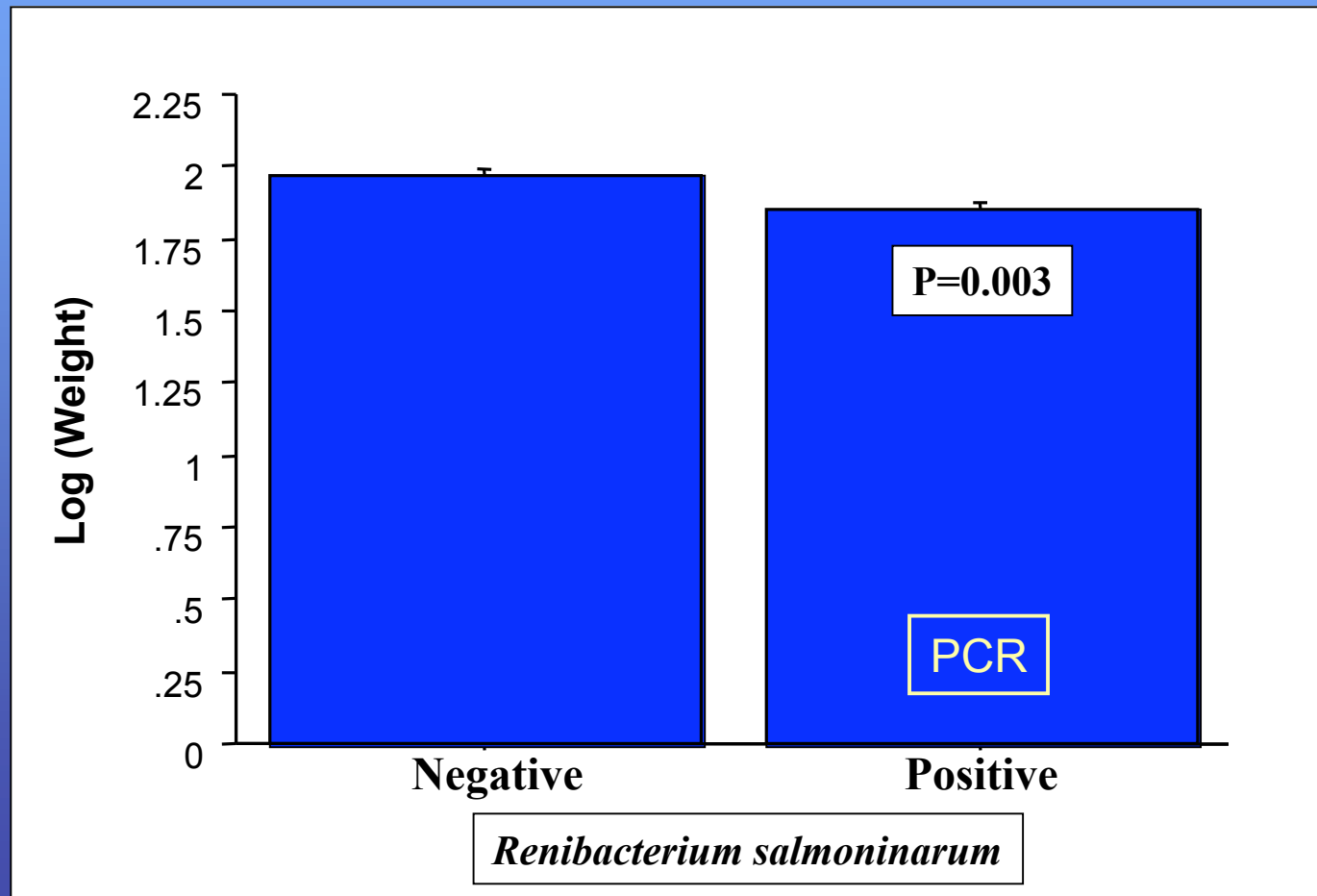


Ocean Sampling

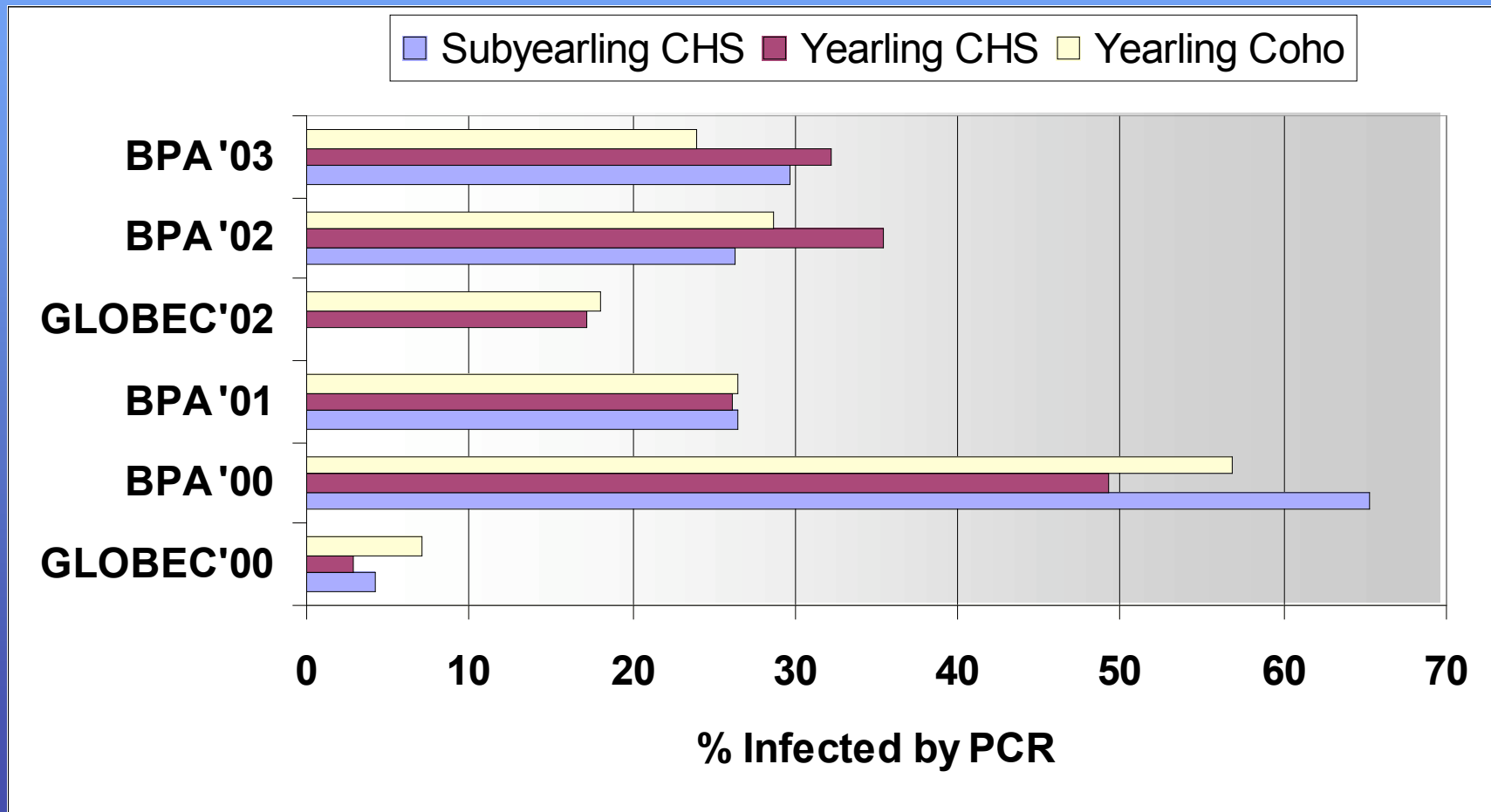


Does *R. salmoninarum* Infection Affect Salmon Condition?

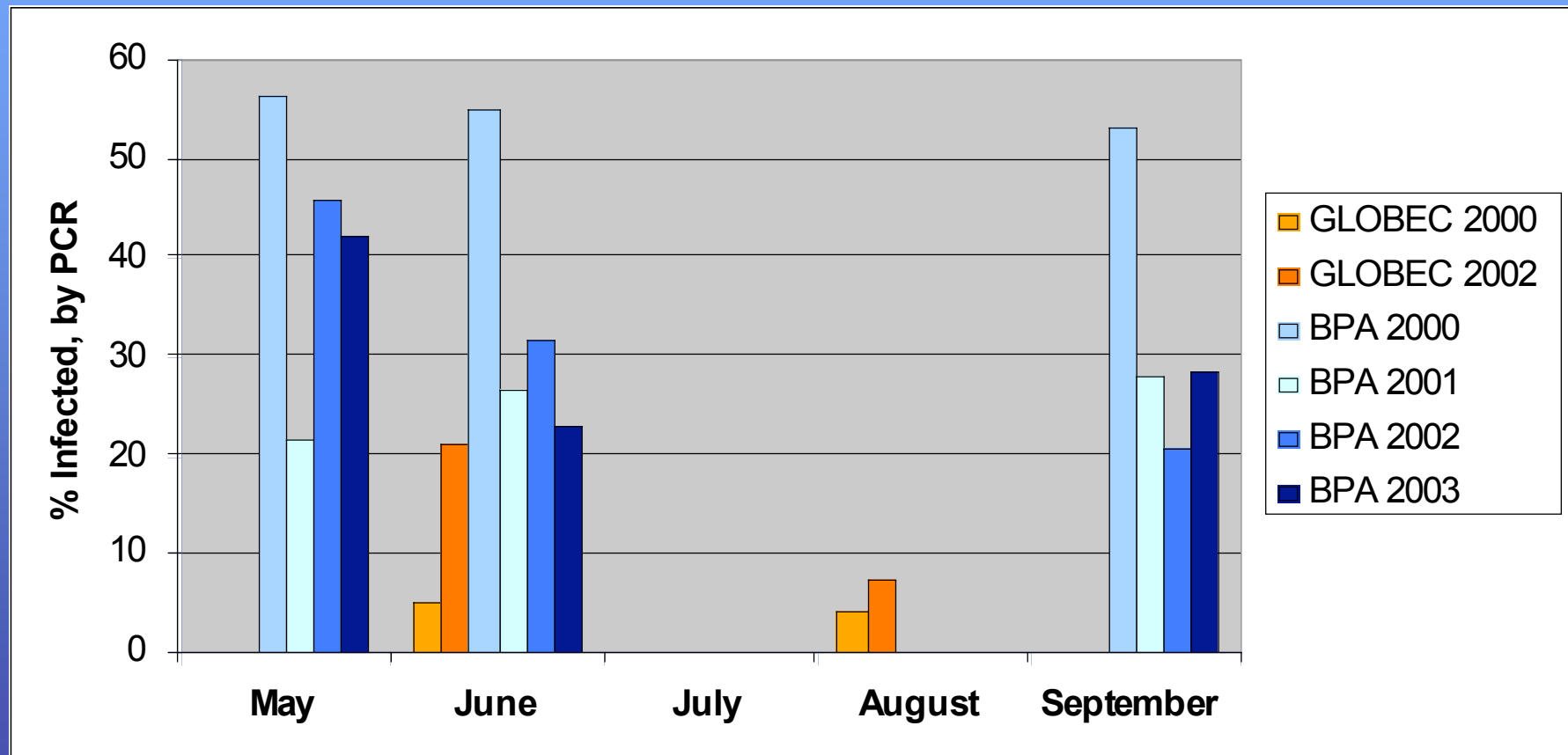
Infection and log (weight) of BPA Study Juvenile Coho Salmon, 2000



R. salmoninarum Prevalences in Juvenile Salmon by Species and Age-Class: BPA and GLOBEC Study Areas

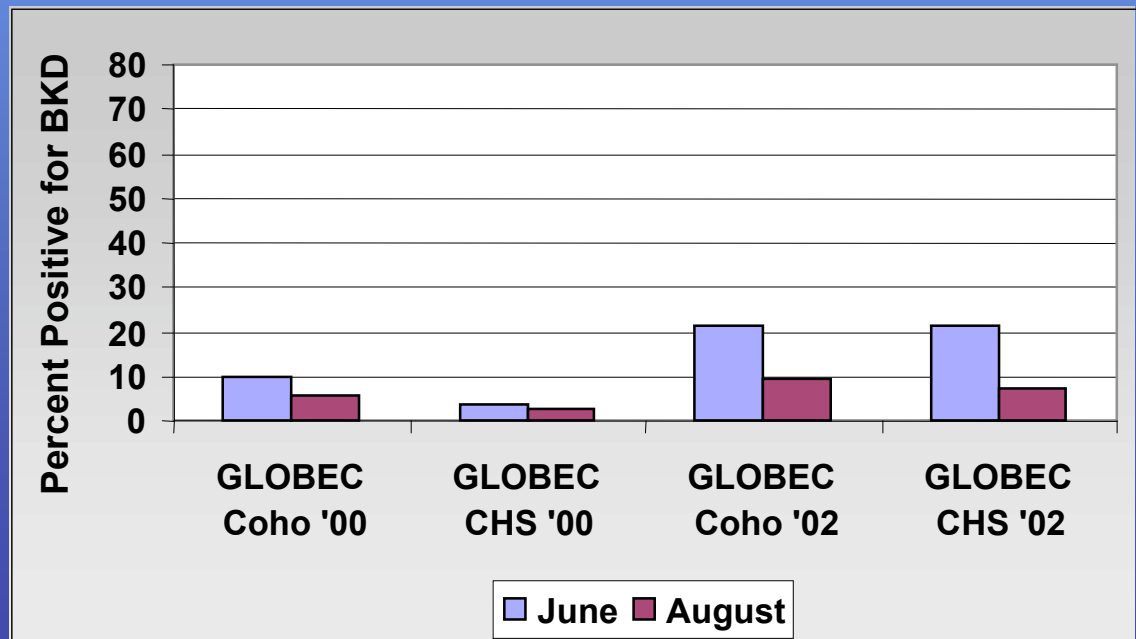
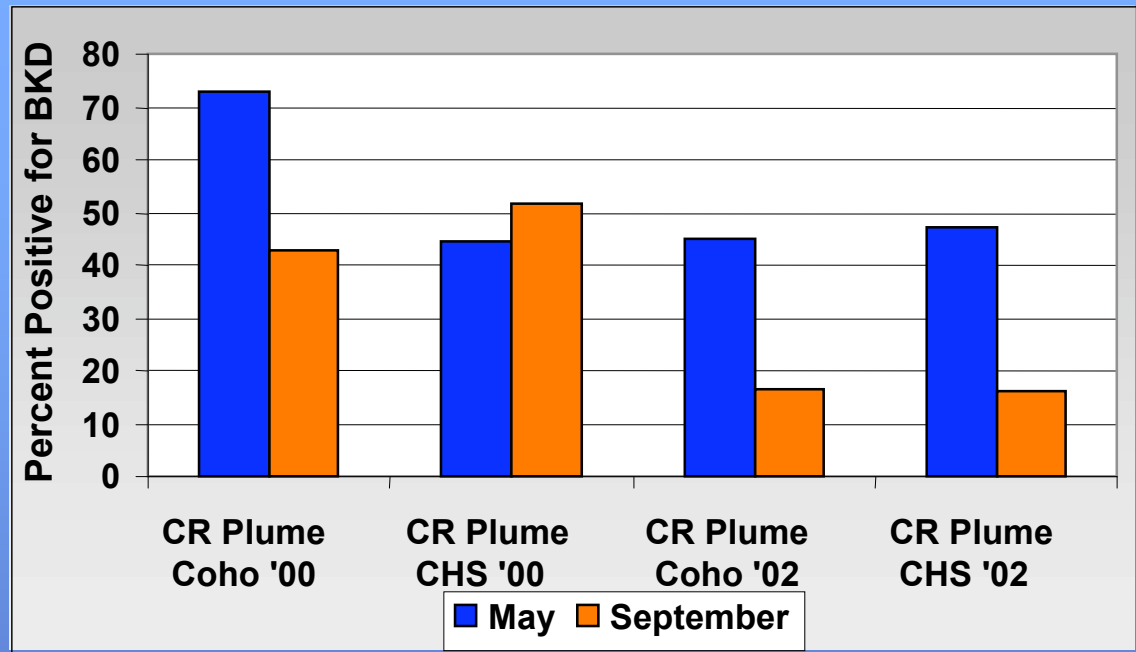


Temporal Variation: *R. salmoninarum* Prevalence by Month, GLOBEC and BPA Studies (Juvenile Chinook and Coho Salmon)

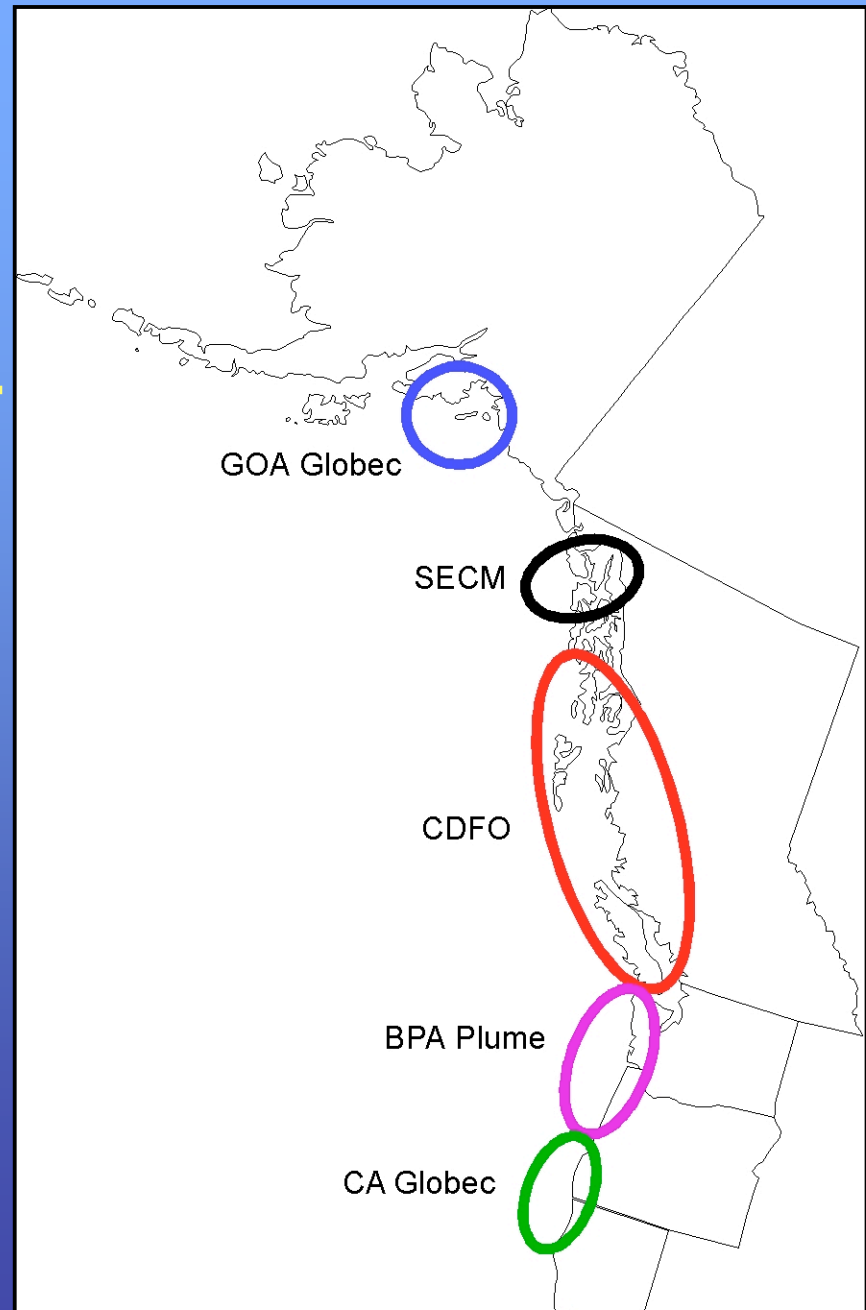


Evidence of *R. salmoninarum*- associated mortality?

Seasonal decline, 2000
and 2002, in both the
GLOBEC and
BPA study areas

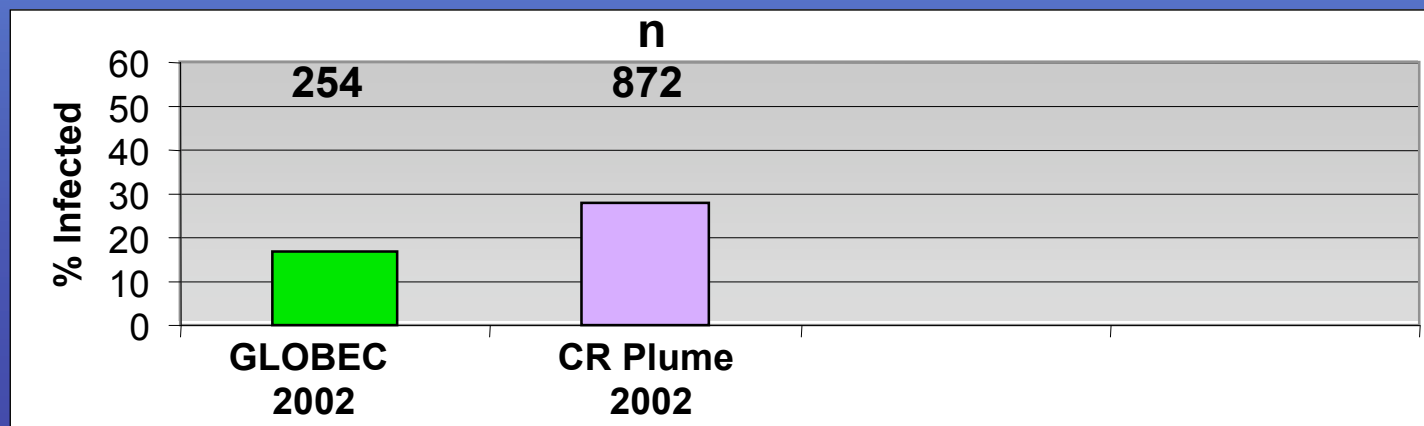
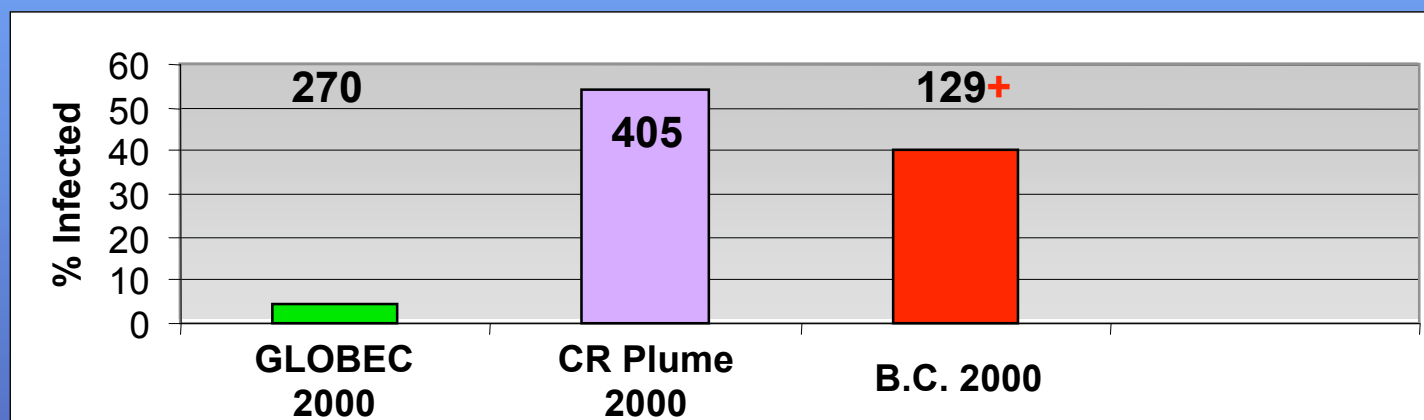
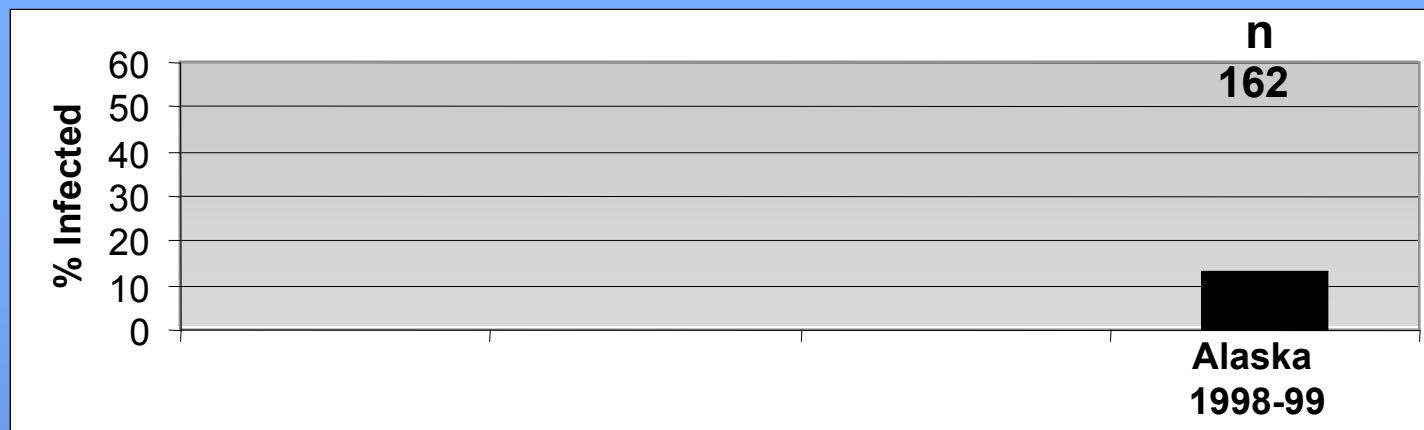


Regional study areas...

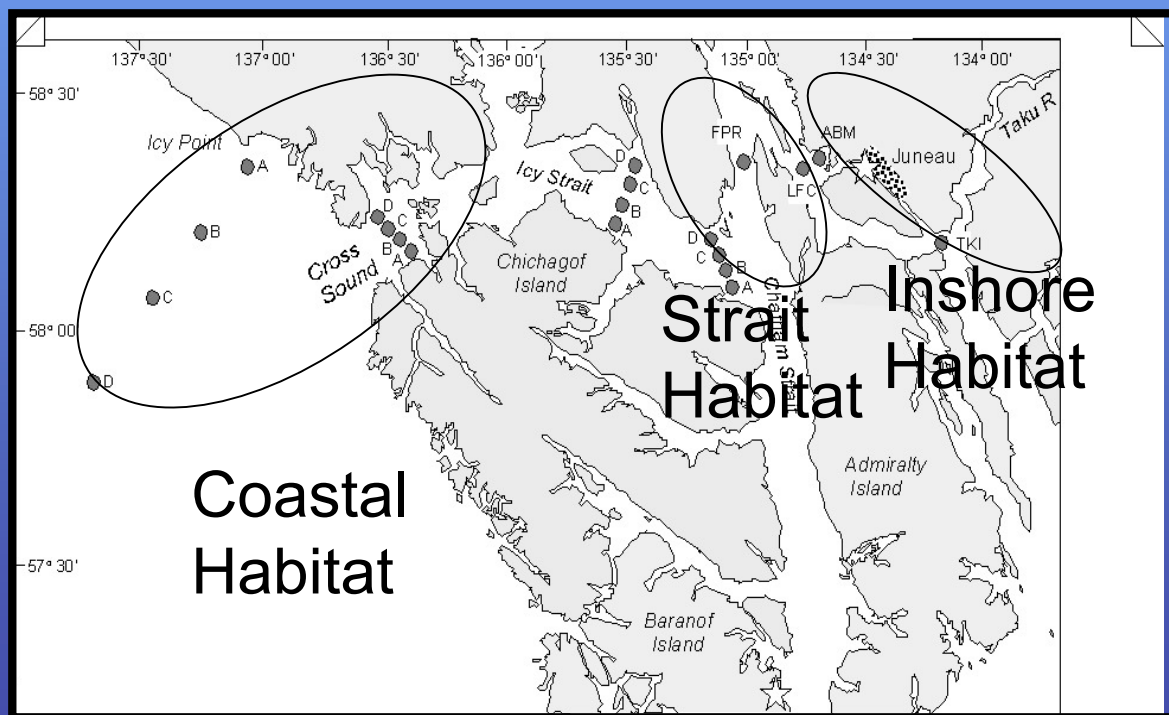
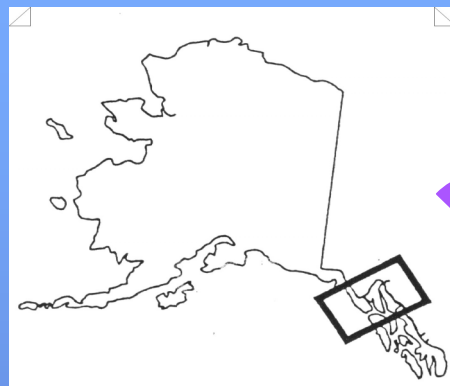


**Ocean *R. salmoninarum*
Prevalences
by Region
and Year
(Juvenile
Chinook/Coho)**

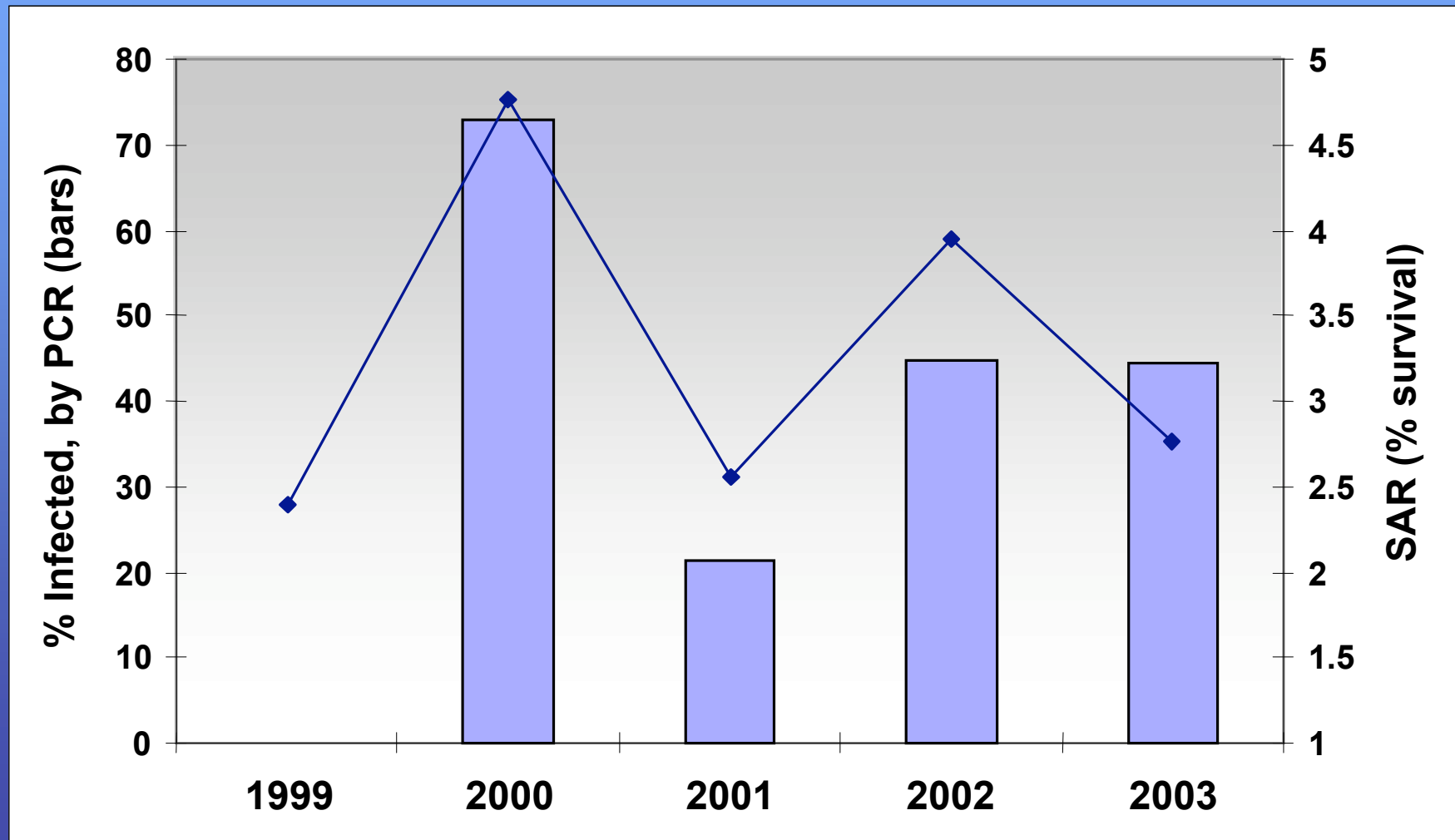
PCR



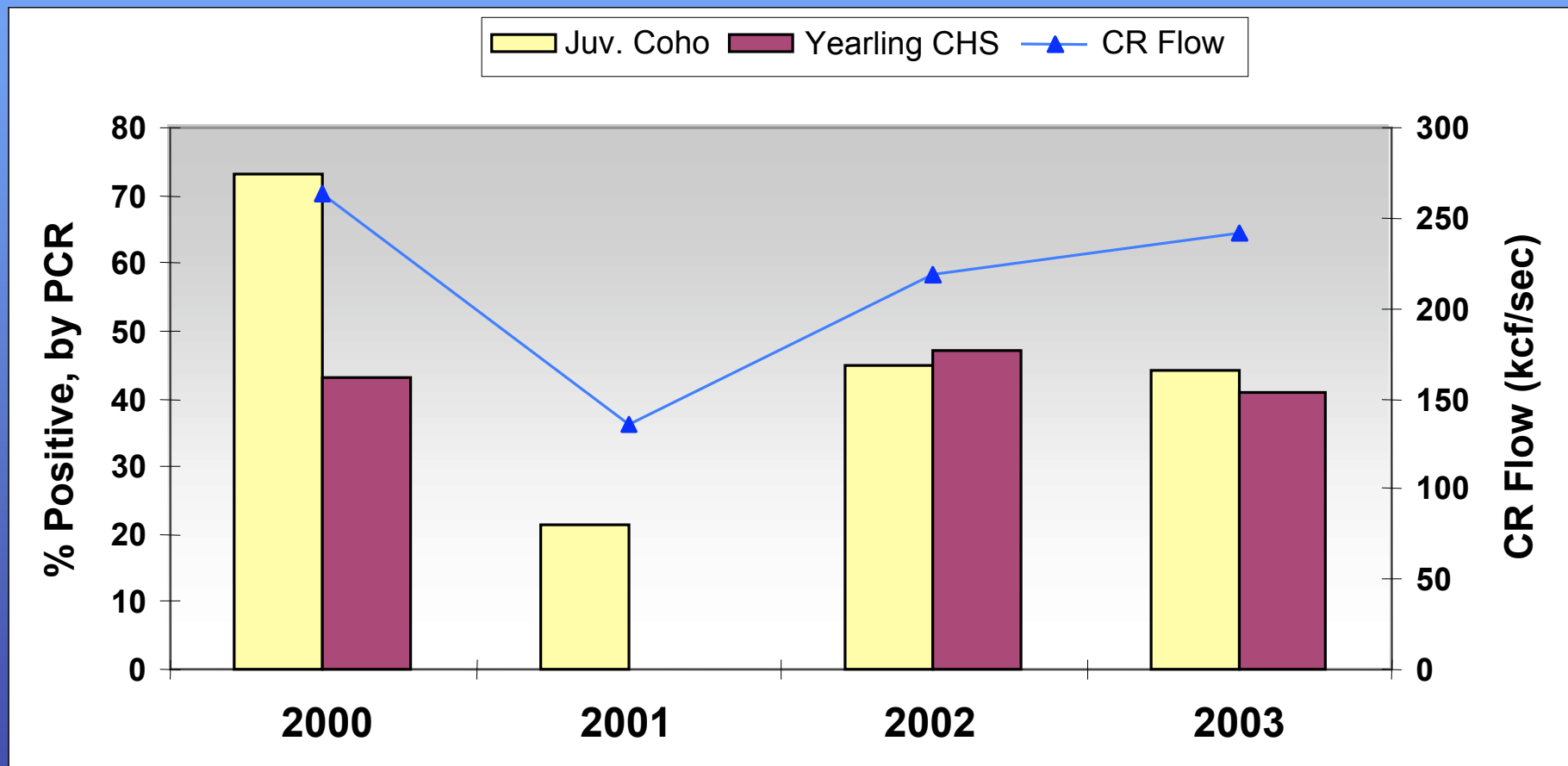
Southeast Alaska Juvenile Chinook & Coho Salmon



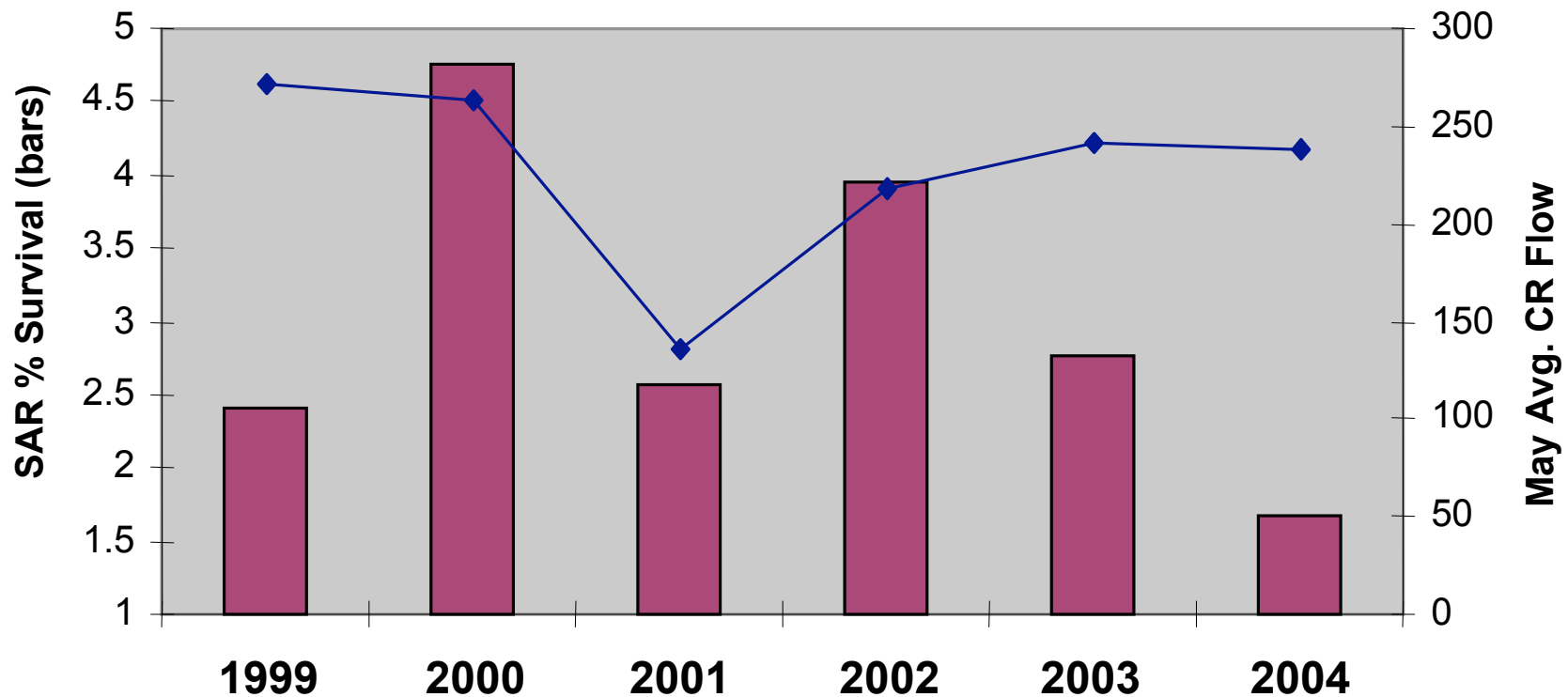
Smolt-to-Adult Returns (SAR) vs. *R. salmoninarum* Prevalence (PCR) in BPA Study Area: May, Coho Salmon Only (SAR is for year of ocean entry)



R. salmoninarum prevalence in Juvenile Salmon vs. 10- Day Average Flow at Bonneville Dam: May only



Coho SAR vs. Average CR Flow at Bonneville Dam, May Only



Summary

- Determine the prevalence and severity of *R. salmoninarum* in ocean-caught juvenile salmon (species and age class)
 - ▶ Juvenile coho and Chinook salmon have similar infection rates
 - ▶ No clear trends showing the pathogen decreases fish “condition”, but some seasonal and regional evidence of disease-related mortality (?)
- Determine if regional/temporal differences in prevalence are present
 - ▶ A regional difference exists in the prevalence of *R. salmoninarum* North and South of the Newport, OR transect; prevalence increases to the North (B.C.), drops in SE Alaska?
 - ▶ Considerable seasonal and interannual (2000!) variation observed
- Are there differences in prevalence between hatchery and naturally-reproducing stocks?
 - ▶ No consistent trends in marked/unmarked prevalences

Additional Findings

- *R. salmoninarum* prevalence appears to fluctuate with CR Flow (May) and, inversely, with smolt-to-adult (SAR) returns (coho only)
- ELISA assay was not sensitive enough to allow disease severity analysis in PCR-positive samples
- Pathogen prevalence tends to be higher on the Columbia River ocean transect than in the estuary

Future Research

- 1) Determine infection prevalence in the same “cohort” (CWT) as they exit the Columbia River and migrate north (Chinook)
- 2) Re-analyze nested PCR-positive samples with QPCR to determine infection severity
- 3) What factors are influencing *R. salmoninarum* prevalence and severity?? Water temperature (ocean and estuary), the plume environment, annual rainfall, turbidity, flow...?
- 4) Analyze samples from emigrating CR fish from FW→SW; evidence of transmission and/or mortality?
- 5) Establish timing of peak infectivity in the Columbia river estuary

ACKNOWLEDGMENTS



We thank the captains and crews of:
F/V Sea Eagle F/V Frosti
F/V Ocean Harvester R/V Ricker



Thanks to Marc Trudel (CDFO)
and Joe Orsi (AFSC) for samples !!



Thanks to all those who went to sea
with us to collect these samples !!!

Brian Beckman

Paul Bentley

Ric Brodeur

Cindy Bucher

Mary Bhuthimethee

Bob Emmett

Joe Fisher

Susan Hinton

George McCabe

Cheryl Morgan

Suzan Pool

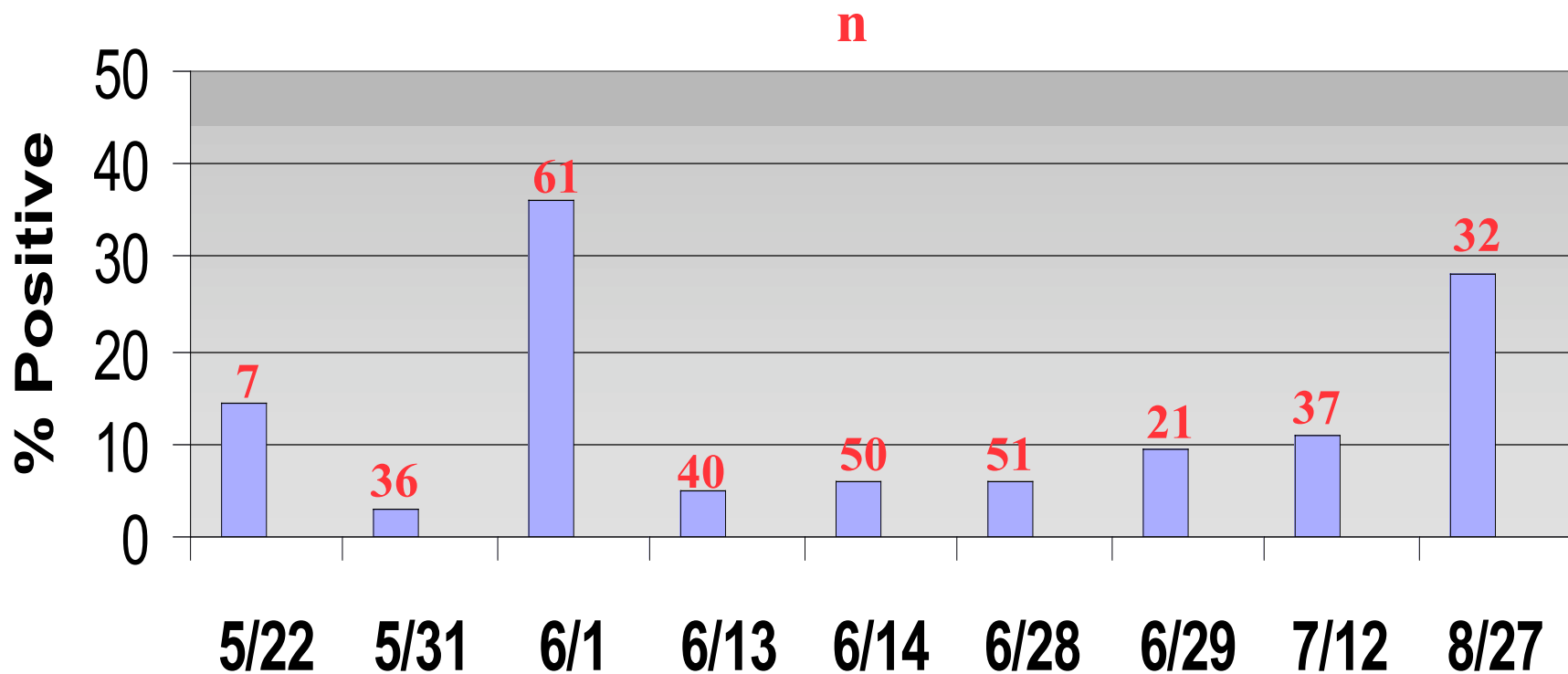
Lidia Sandoval

David Teel

Laurie Weitkamp



Estuary 2001 BKD Combined Prevalence by Sampling Date: Juvenile Coho and Chinook Salmon



Can Parasites/Pathogens Limit Populations??

- “Parasite” vs. “pathogen”
- The difficulty of discerning pathogen- induced mortality from predation, competition for resources, etc. plus affects on fecundity, etc.
- Controlled studies: Hudson et al. (1998); cyclical grouse population crashes controlled by nematode infection
- Patterson (1996); modeled impact of *Ichthyophonus* fungus on Herring populations

The Evolution of Detection Assays for *R. salmoninarum*

Least Sensitive

Pre 1980- Gram Staining/ Microscopy

1980- direct Fluorescent Antibody Technique (FAT)

1987- Membrane Fluorescent Antibody Technique (M-FAT)

1987- Enzyme-Linked Immunosorbent Assay (ELISA)

1994- Nested Polymerase Chain Reaction (PCR)

1999- Reverse Transcriptase PCR (RT-PCR)

Quantitative/ Real-Time PCR (Q-PCR)

Bacterial culture continues to
be a very sensitive, but slow,
method of detection

Most Sensitive